



# Sustainable TRANSPORTATION



Energy Efficiency &  
Renewable Energy

## US/EU EV-Smart Grid Interoperability Centers

*Harmonization of standards, technology and test procedures  
to support vehicle-grid integration*

April 2016 Overview

Courtesy of Keith Hardy

ANL Center for Transportation Research

Energy Systems Division, Argonne National Laboratory

## Transatlantic Agreement



DOE Asst. Sec. David Sandalow and former JRC DG Dominique Ristori signing the Letter of Intent to establish EV-Smart Grid Interoperability Centers in the US and EU, November, 2011. Witnessed by EC Commissioner for Digital Economy and Society, Günther Oettinger, then EC Trade Commissioner, Karel DeGucht, and current US Trade Representative, Michael Froman. (Courtesy US State Dept.)

### Work Plan for Advancing Transatlantic E-mobility Cooperation (November 2011)

- Adopted by Transatlantic Economic Council to help prevent unnecessary regulatory divergence and promote EV-smart grid interoperability

### Priorities

- Common or compatible standards for EVs
- Cooperation among regulators
- Joint research - charging, energy storage, safety
- Compatible EV-grid communication

### Pilot Projects

- EV-Smart Grid Interoperability Centers at Argonne National Laboratory and Joint Research Centre – Institute for Energy and Transport
- Electric vehicles and smart charging infrastructure as an integral part of a smart energy community approach

# Role of E-Mobility ... *societal perspective*

Originally ...

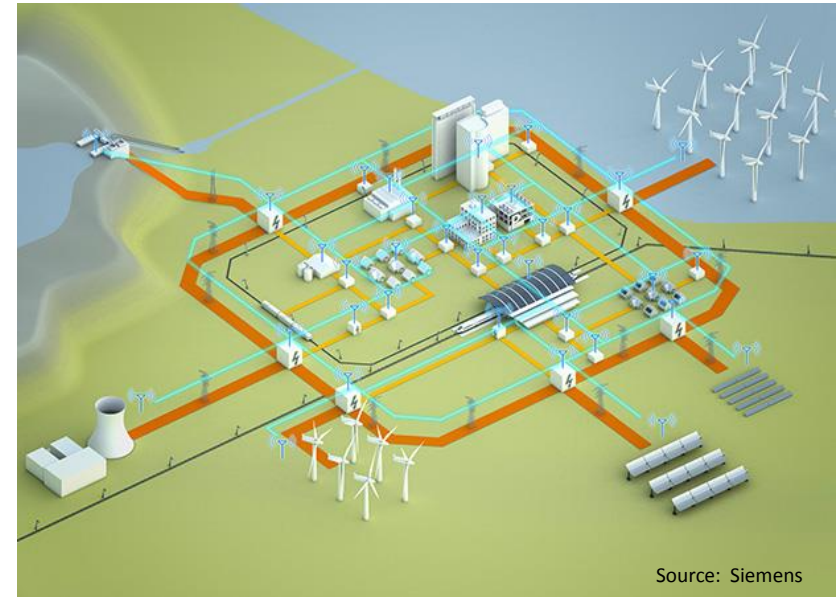
**Decrease emissions/petroleum consumption in transportation**

More recently ...

**Utilize multiple electric power generation sources from a continually improving grid**

**Contribute to local/regional energy management**

- Controllable load, e.g., demand response and/or smart charging
- V2X ... store energy/provide power
  - Ancillary/emergency services
  - Integration with renewables
  - Behind-the-meter integration with smart building systems



# EV-Grid Integration ... *an Enabler for Societal Benefits*

## Interoperability is key to smart charging and grid integration

*'the ability to charge conveniently, safely and securely ... anywhere, anytime ... with no extraordinary actions required by the vehicle operator'*

- Connectivity and communication for EVs and the grid were developed independently
- EV-grid interfaces must be harmonized
- Interoperability must be verified

Harmonize interfaces,  
interoperability requirements  
& compliance tools



# Enabling Technologies

**Harmonization of standards and/or new technology** is required to adapt physical interfaces and translate message protocols to implement smart grid integration

**Necessitates development** of compact metrology, communication controllers and protocol translation software

Technology needed to  
adapt interfaces and  
support advanced features



Metrology;  
'sub-meters'



Communication controllers  
and protocols



AC, AC inductive  
and DC charge  
couplers





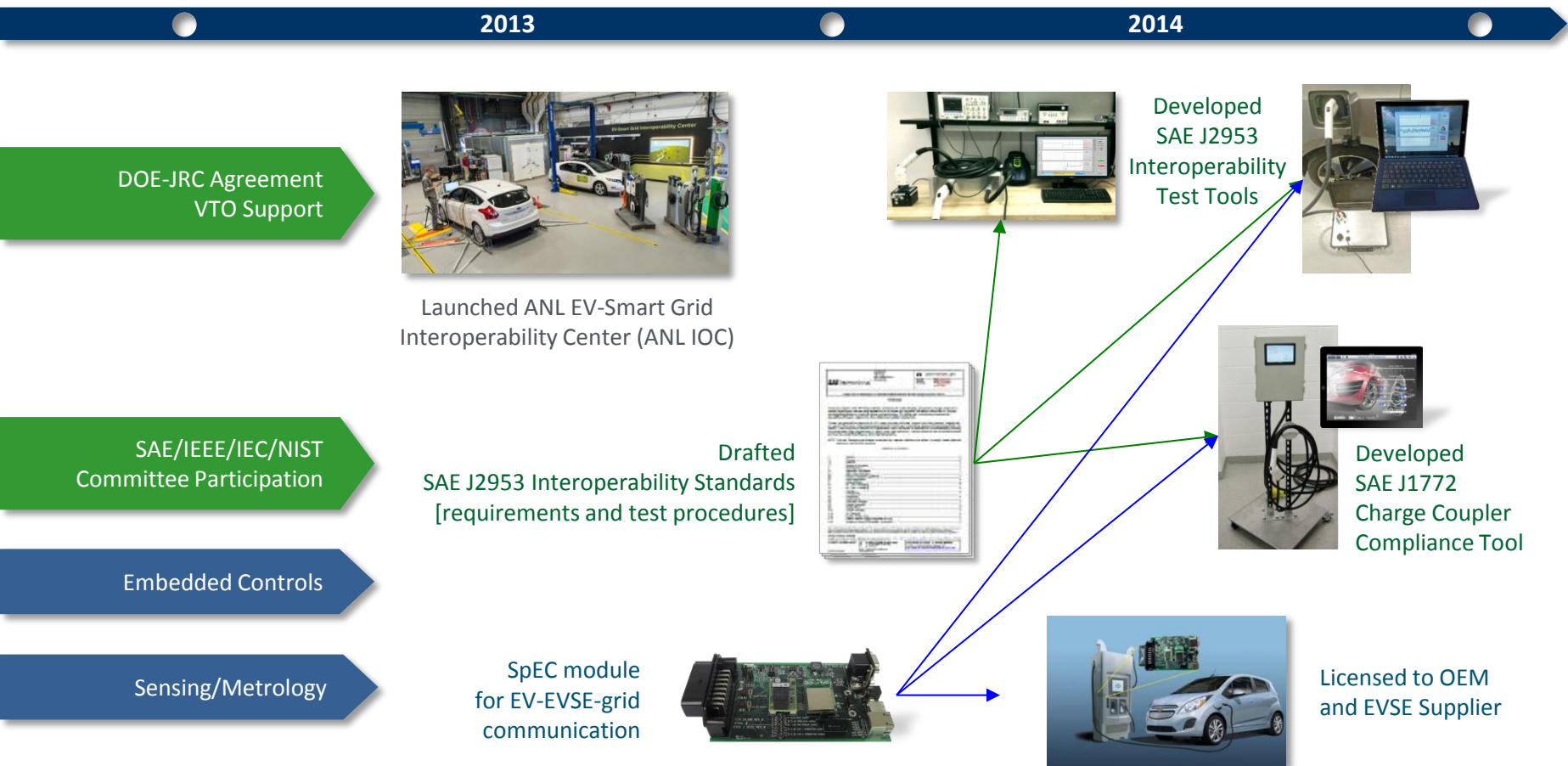
# DOE/ANL EV-Smart Grid Interoperability Center

- **Develops and verifies technology and standards** for grid integration
- **Develops open source embedded controls** to minimize technical barriers for industry to integrate grid-connected devices
- **Tests communication and control systems in a network of grid-connected devices** to demonstrate practical, behind-the-meter integration of workplace charging with the needs and capabilities of building systems, renewables and storage
- **Supports international harmonization** through coordination with Europe's Joint Research Centre and Global InterOP (i.e., multi-national auto OEMs, JRC-IET, ANL)



# ANL IOC Has Focused on EV Interoperability ...

## Argonne led development of standards and compliance tools



# And Supporting Global Harmonization ...

## Universal EV Interoperability and Verification

2014

2015

### Collaborate on Interoperability Testing and Equipment



EVSE Thermal Testing; JRC IOC



EV-EVSE Interoperability Testing; JRC IOC



Wireless EVSE Testing; ANL IOC



Joint ISO-SAE Communication Standards Meeting and Interoperability Testing; ANL IOC

### Support the Global InterOP Team

- AC Interoperability use cases, test procedures, equipment (ANL IOC)
- AC interoperability testing (ANL IOC)
- Commercial test equipment evaluation (JRC IOC)
- EV-EVSE compatibility/thermal testing (JRC IOC)
- Joint development of global use cases and requirements



DAIMLER



Global Requirements and Test Tools



Phase 2 AC and DC Test Equipment

### Harmonize EV Test Procedures

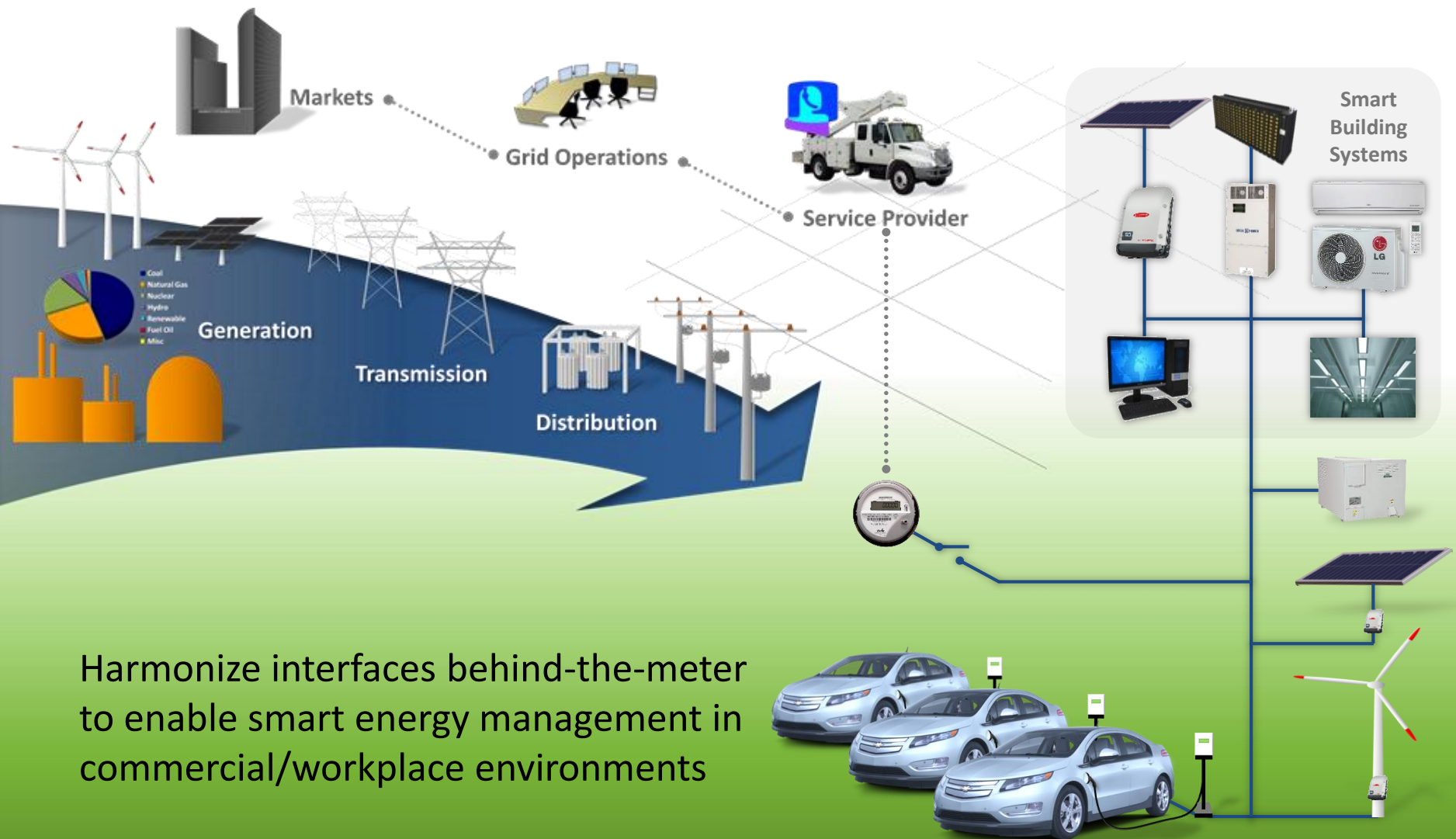
Level 2 instrumentation and testing at ANL APRF



Testing at JRC VELA



# Now Applying Technology to Grid Integration

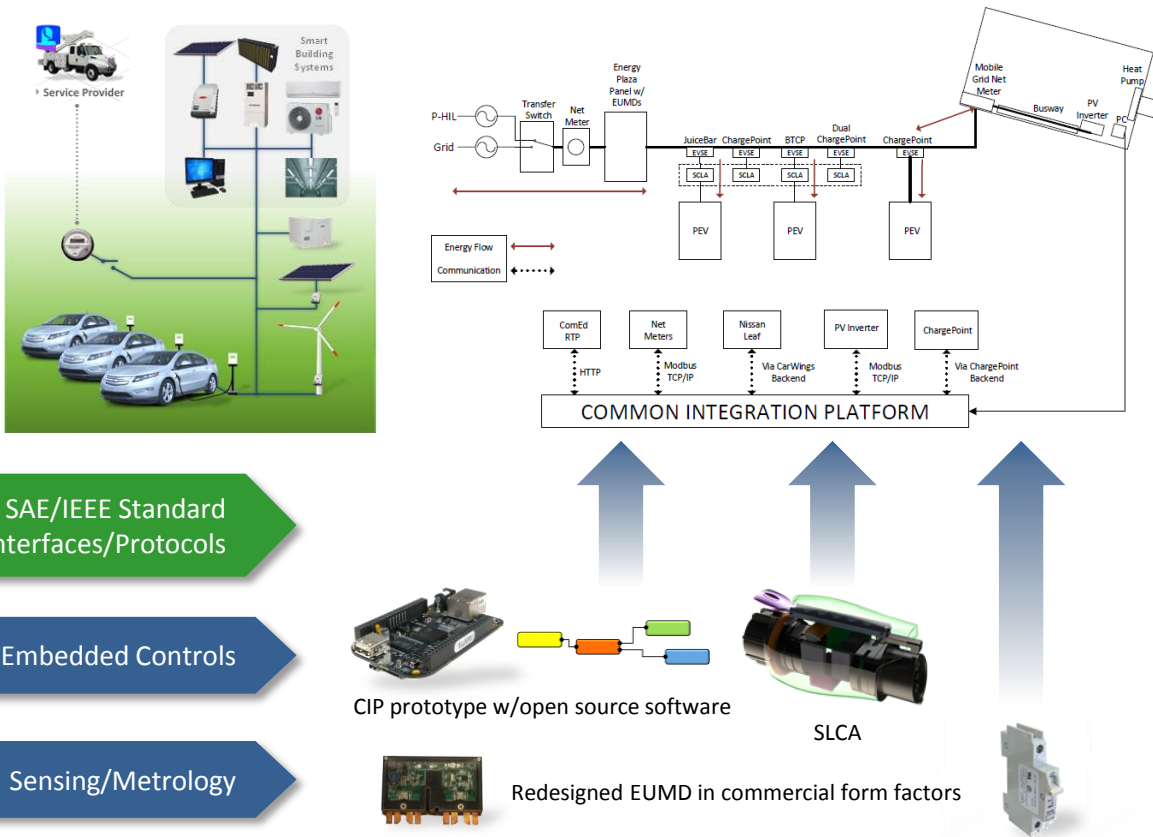


Harmonize interfaces behind-the-meter to enable smart energy management in commercial/workplace environments

# Grid Integration ... Sensing, Communication and Control

## Harmonize interfaces using Internet of Things (IoT) Approach

2015



- Common integration platform (CIP) with open source software
- Energy plaza with networked EVs, EVSE, building systems and photovoltaic array
- Prototype sub-meter/load control adaptor (SLCA)

SAE/IEEE Standard  
Interfaces/Protocols

Embedded Controls

Sensing/Metrology

# EU Interoperability Centre at JRC Ispra

- Combines four state-of-the-art laboratories, which focus on energy efficiency of electric and hybrid vehicles; interoperability of smart grids; electromagnetic compatibility; and battery testing.
- Testing of sixteen different full electric and plug-in hybrid vehicles with more than 60 different charging devices from EU, U.S. and Swiss producers
- Development of a portable system to monitor electric and functional parameters to measure energy efficiency and the electric driving range under real world driving conditions.



EC EV and Smart Grid IOC Launch Event (October 2015)

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# Thank you

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